

Revision of the genus *Shairella* Chûjô, 1962 (Coleoptera: Chrysomelidae: Galerucinae) from Taiwan, with descriptions of five new species

CHI-FENG LEE¹ & RON BEENEN²

¹Applied Zoology Division, Taiwan Agricultural Research Institute, Taichung 413, TAIWAN. E-mail: chifeng@tari.gov.tw

²Martinus Nijhoffhove 51, NL-3437 ZP Nieuwegein, THE NETHERLANDS. E-mail: r.beenen@wx.nl

Abstract

The brachelytrous galerucine genus *Shairella* Chûjô is reviewed based on examination of 240 specimens. Five new species are described: *S. cheni* sp. nov., *S. chungi* sp. nov., *S. guoi* sp. nov., *S. motienensis* sp. nov., and *S. tsoui* sp. nov. The diversity and distribution of most of *Shairella* species are reflected on one major host plant - *Clinopodium laxiflorum* var. *taiwanianum*. Smaller compound eyes relative to otherwise similar galerucines are characteristic for *Shairella* and may be related to nocturnal behavior. The occurrence of a subapical white band on the antenna and its possible function is discussed.

Key words: Leaf beetles, *Clinopodium laxiflorum* var. *taiwanianum*, *Hemiboea bicornuta*, *Strobilanthes flexicaulis*, nocturnal behavior, taxonomic revision

Introduction

Shairella is a little-known galerucine genus endemic to Taiwan. Chûjô (1962) described the genus for *S. aeneipennis* Chûjô based on two specimens. Later, Kimoto (1984) described *Khasia itorum* Kimoto based on four specimens. That species subsequently was synonymized with *Shairella aeneipennis* (Kimoto & Chu 1996). Until now, no other taxonomic studies have been published on *Shairella*. Wilcox (1971-1975) classified *Shairella* in the section Adoxiites in the tribe Luperini without providing a description of the section. The section name is therefore not an available family group name (Beenen 2010; Bouchard *et al.* 2011).

The basic bionomics of *Shairella* populations can be summarized as follows: adults are nocturnal and closely associated with their host plants: *Clinopodium laxiflorum* var. *taiwanianum* Hsieh & Huang (Labiatae) (Figs 1A, 1B); *Strobilanthes flexicaulis* Hayata (Acanthaceae) (Fig. 1C), and *Hemiboea bicornuta* (Hayata) Ohwi (Gesneriaceae) (Fig. 1D). These plants are widely distributed and grow on the edges of forests and along roads, walking trails, and rivers. These environments are easily accessible, so adults can be collected by searching host plants at night. Approximately 240 specimens have been collected throughout Taiwan by members of the Taiwan Chrysomelid Research Team (TCRT) led by the first author.

Materials and methods

Live larvae were put into small glass containers (diameter 142 mm x height 50 mm) with cuttings from their host plants at average 20.8°C, 74%RH, with a photoperiod of 12:12 (L:D) for laboratory rearing. When mature larvae began searching for pupation sites, they were transferred to smaller plastic containers (diameter 90 mm x height 57 mm) filled with moist soil (about 80% of container volume).

To prepare genitalia for drawing purposes, abdomens of adult specimens were separated from the bodies and boiled in 10% KOH solution, followed by washing in distilled water. Genitalia were then dissected from the abdomen, mounted on slides in glycerin, and examined and drawn using a Leica M165 stereomicroscope. For more detailed examination a Nikon ECLIPSE 50i compound microscope was used.

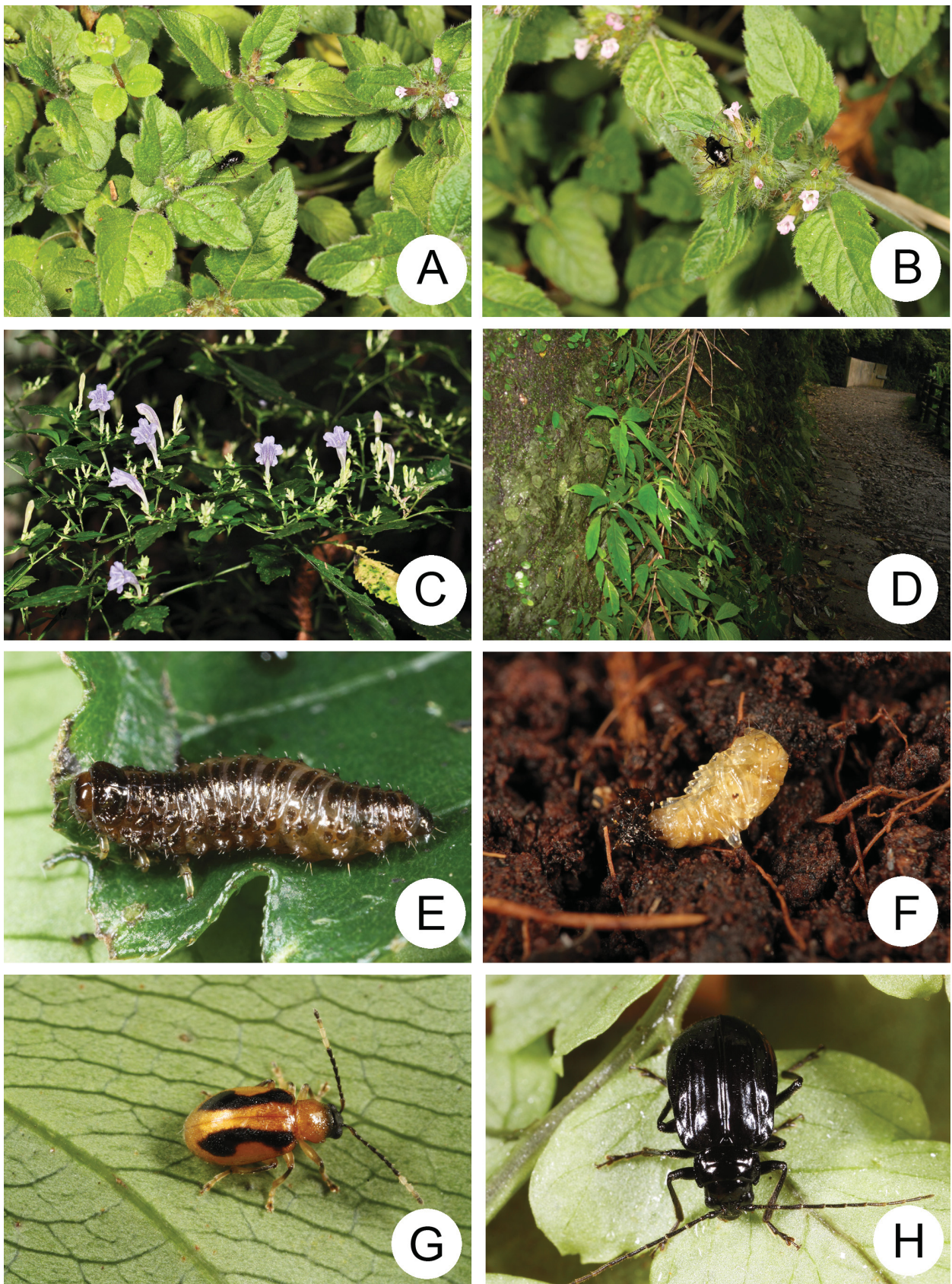


FIGURE 1. Field photography. 1A. Male of *Shairella guoi* sp. nov. feeding on *Clinopodium laxiflorum* var. *taiwanianum*; 1B. Flowers of *Clinopodium laxiflorum* var. *taiwanianum*; 1C. *Strobilanthes flexicaulis*; 1D. *Hemiboea bicornuta*; 1E. Larva of *S. guoi* sp. nov. feeding on leaves of *Strobilanthes flexicaulis*; 1F. Pupa of *S. guoi* sp. nov.; 1G. Adult of *Medythia suturalis*; 1H. Adult of *Japonitata quadricostata*.

At least two pairs representing each species were examined to delimit the variability of diagnostic characters. When a species was collected from more than one locality, at least one pair from each locality was examined. Identifications of females to species were based on associations with identified males from collecting localities. Length was measured from the anterior margin of the eye to the elytral apex, and width at the greatest width of the elytra.

Specimens studied for this project are deposited at the following institutes: KMNH: Kitakyushu Museum of Natural History and Human History, Kitakyushu, Japan [Yūsuke Minoshima]; OMNH: Osaka Museum of Natural History, Osaka, Japan [Shigehiko Shiyake]; RBCN: Ron Beenen collection, Nieuwegein, The Netherlands; TARI: Taiwan Agricultural Research Institute, Taichung, Taiwan.

Exact label data are cited for all type specimens of described species; a double slash (//) divides the data on different labels and a single slash (/) divides the data in different rows. Other comments and remarks are in square brackets: [p]—preceding data are printed, [h]—preceding data are handwritten, [b]—blue label, [r]—red label, [w]—white label, [y]—yellow label.

Genus *Shairella* Chûjô

Shairella Chûjô, 1962: 101 (type species: *Shairella aeneipennis* Chûjô, 1962, by original designation).

Description. Body size small (length 4.3–7.3 mm), shape oval, convex. General color shining black; antennomeres VII and VIII white, sometimes extending to IX and X.

Head. Labrum transverse, with rounded anterior angles, anterior margin concave, dorsally with few setigerous punctures. Frontal tubercles subtriangular, with anterior angles divergent, basally separated from frons by impressed line. Interocular space wide, 3.2–3.3 times as wide as transverse diameter of eye. Interantennal space 1.2–1.3 times as wide as transverse diameter of antennal socket. Eyes small. Vertex wide, moderately convex and glabrous. Antennae with 11 antennomeres, as long as or slightly longer than body.

Pronotum transverse, about 1.9–2.0x as wide as long. Anterior margins broadly concave, posterior margin truncate or slightly concave, lateral margins posteriorly narrowed. Only lateral margins widely bordered; all margins without setae. Each angle bearing one setigerous puncture and a long pale seta. Surface glabrous, indistinctly finely punctate, with a pair of distinct depressions laterally. Scutellum large, subtriangular.

Elytra convex, posteriorly widened, widest near apex, with punctation sparse and randomly arranged; without setae except several minute setae along longitudinal ridge. One distinct ridge arising from humerus, longitudinal, reduced before apical 1/3. Epipleura slender, gradually narrowed apically, and disappearing before apices. Brachelytrous. Hind wings absent.

Legs slender, apices of all tibiae lacking spines. First metatarsomere elongate, 1.2x as long as following two tarsomeres combined. All claws normal and appendiculate. Procoxal cavities closed, intercoxal prosternal process wide, not elevated, visible between procoxae. Posterior margin of last ventrite with short distinct incisions in male, central lobe evenly rounded and flat, disc largely and triangularly depressed.

Aedeagus slender, parallel-sided, apically narrowed, moderately curved in lateral view; with one longitudinal endophallic sclerite, with one cluster of setae at basal 1/3, and basally bifurcate.

Females. Abdomen with last ventrite truncate or slightly convex or notched (in *S. tsoui* sp. nov.). Spermatheca slender, as wide as pump, hardly separated from pump; pump wide and strongly curved, apex widely rounded, apex with transverse, short sclerite, size variable; proximal spermathecal duct hardly separated from receptacle, apically narrowed. Gonocoxae longitudinal, conjoined from base to middle, slightly narrowed at apical 1/3, apices rounded, each gonocoxa with seven to nine elongate setae. Ventrite VIII with only apical area and spiculum sclerotized; with dense elongate setae inside apical sclerotized area, apical margin rounded; spiculum elongate and wide.

Diagnosis. The genus *Shairella* is among the genera classified by Wilcox (1971–1975) in the section Adoxiites, characterized by the wide pronotum in combination with the unmarginated basal border. It is similar to *Shaira* Maulik, 1936 but apart from the characters mentioned before, all species in *Shairella* have the humerus raised, whereas it is flat in *Shaira*. Also, the procoxal cavities in *Shaira* are open whereas they are closed in *Shairella*. The genus *Khasia* Jacoby, 1899 (type species *Khasia kraatzi* Jacoby, 1899) is characterized by a square pronotum which seems elongate due to the strong constriction in the basal half. Moreover, *Khasia* species are small species with complete elytra that bear relatively long bristles.

Biology. *Shairella* species appear to be univoltine based on field observations (unpublished data TCRT). Larvae are diurnal and found on the host plant's leaves during late February. They are easily discovered when feeding on the tops of leaves during the day (Fig. 1E). Larval development takes about one month, based on laboratory rearing. Mature larvae leave the host plant and burrow into the soil where they build underground chambers for pupation. Pupal stage (Fig. 1F) duration is about 20 days, and adults begin to emerge after early April. Adults are nocturnal and have been observed in the field from May to August.

Distribution. Endemic to Taiwan.

Shairella aeneipennis Chûjô

(Fig. 2)

Shairella aeneipennis Chûjô, 1962: 105; Wilcox, 1973: 443 (catalogue); Kimoto & Chu, 1996: 61 (catalogue); Kimoto & Takizawa, 1997: 388; Beenen, 2010: 487 (catalogue).

Khasia itorum Kimoto, 1984: 56; Kimoto & Chu, 1996: 61 (as synonym of *Shairella aeneipennis*). **Synonym confirmed.**

Type locality. Chiayi County, Chushan (祝山), 23°30'44"N, 120°49'22"E, 2400 m.

Types. *Shairella aeneipennis*. Holotype ♂ (TARI): "Iwai-yama (= Chushan, 祝山) / Mt. Arisan (阿里山) / Tainan-syu / FORMOSA / 6.viii.1940 / Col. K. ENDO [p, w] // *Shairella / aeneipennis / CHÛJÔ [h] / DET. M. CHUJO [p, w] // HoLo / Type [p, w] (circle label, red letters but faded) // 2315 [p, w]".*

Khasia itorum. Holotype ♀ (OMNH): "Mt. ALI (阿里山) / TAIWAN / 17.V.1981 / T. ITO [p, y] // *Khasia / itoi / Kimoto, n. sp. [h, w] // HOLOTYPE [p, r]*". Paratypes: 2♂ (KMNH, OMNH): "Mt. ALI / TAIWAN / 17.V.1981 / T. ITO [p, y] // *Khasia / itoi / Kimoto, n. sp. [h, w] // PARATOPOTYPE [p, b] // PHOTO [p, r]*"; 1♂ (KMNH): "Mt. ALI / TAIWAN / 18.V.1981 / N. ITO [p, y] // *Khasia / itoi / Kimoto, n. sp. [h, w] // PARATYPE [p, b] // (blank) [w]*".

Additional specimens examined (n=34). Chiayi: 6♂, 3♀ (TARI, RBCN), Alishan (阿里山), 17.V.2010, leg. M.-H. Tsou; 1♂, 1♀ (TARI), Erhwanping (二萬坪, near Alishan), 9.V.2011, leg. T.-H. Lee & M.-H. Tsou; **Nantou:** 1♂ (TARI), Hsitou (溪頭), 14.VI.2011, leg. T.-H. Lee; 1♂ (TARI), 24-31.VII.2008, leg. C.-S. Tung; Tatachia (塔塔加), 1♂, 5♀ (TARI), same locality, 8.VI.2009, leg. C.-F. Lee; 5♂, 4♀ (TARI), same locality, 20.VII.2009, leg. C.-F. Lee, H. Lee & S.-F. Yu; 1♀ (TARI), same locality, 21.IX.2009, leg. C.-F. Lee; 4♂, 1♀ (TARI), same locality, 16.V.2010, leg. M.-H. Tsou; 1♂ (TARI), same locality, 9.VII.2014, leg. C.-F. Lee.

Males. Length 4.7–5.2 mm; width 2.9–3.1 mm. Antenna (Fig. 2A) long, filiform, about 1.2x longer than body, length ratios of antennomeres I–XI 1.0 : 0.3 : 0.7 : 1.0 : 0.9 : 1.0 : 1.0 : 1.0 : 0.9 : 0.9, length to width ratios of antennomeres I–XI 3.1 : 1.5 : 2.7 : 3.4 : 3.4 : 4.2 : 4.4 : 4.2 : 4.5 : 4.3 : 4.7. Elytra strongly widened apically; about 1.1x longer than wide; surface with sparse, fine punctures. Apical margin of last abdominal ventrite with two well developed incisions. Penis (Figs 2C–2D) elongate, about 5.8x longer than wide, parallel-sided, apex narrowly rounded, strongly curved in lateral view; endophallic sclerite short, about 0.5x as long as penis, slender and longitudinal, apex rounded, with dense, short hairs along lateral margin at apical 1/4, bifurcate at basal 1/4.

Females. Length 5.0–5.2 mm, width 3.0–3.1 mm. Antenna (Fig. 2B) long, filiform, about 1.1x longer than body, length ratios of antennomeres I–XI 1.0 : 0.3 : 0.7 : 0.9 : 0.8 : 0.8 : 0.8 : 0.8 : 0.9 : 0.8 : 0.9, length to width ratios of antennomeres I–XI 3.6 : 1.4 : 3.1 : 4.1 : 3.9 : 4.2 : 3.9 : 4.3 : 5.0 : 4.7 : 5.8. Elytra strongly widened apically; about 1.1x longer than wide; surface with sparse, fine punctures. Apical margin of last abdominal ventrite truncate. Gonocoxae (Fig. 2E) longitudinal and wide, 3.1x longer than wide, conjoined from base to middle, slightly narrowed at apical 1/3, apices rounded, each gonocoxa with eight or nine elongate setae. Ventrite VIII (Fig. 2F) with only apical area and spiculum sclerotized; with dense, elongate setae inside apical sclerotized area, apical margin rounded; spiculum elongate, wide. Receptacle of spermatheca (Fig. 2G) slender, as wide as pump, hardly separated from pump; pump wide, strongly curved, apex broadly rounded, apex with transverse and short appendix, size variable (Fig. 2H); proximal spermathecal duct hardly separated from receptacle, apically narrowed.

Differential diagnosis. *Shairella aeneipennis* is similar to *S. guoi* sp. nov. and *S. motienensis* sp. nov. by possessing fine punctures on the elytra; but this species differs others by the shorter endophallic sclerite of the penis (Figs 2C–2D) (longer endophallic sclerite in *S. motiensis* (Figs 9C–9D)), rounded apex of the endophallic sclerite (depressed apex of the endophallic sclerite in *S. guoi* sp. nov. (Figs 8C–8D) and pointed apex in *S.*

motiensis sp. nov.), and the narrowed apex of the penis (tapering apex from apical 1/6 in *S. guoi* sp. nov. and lanceolate apex in *S. motienensis* sp. nov.).

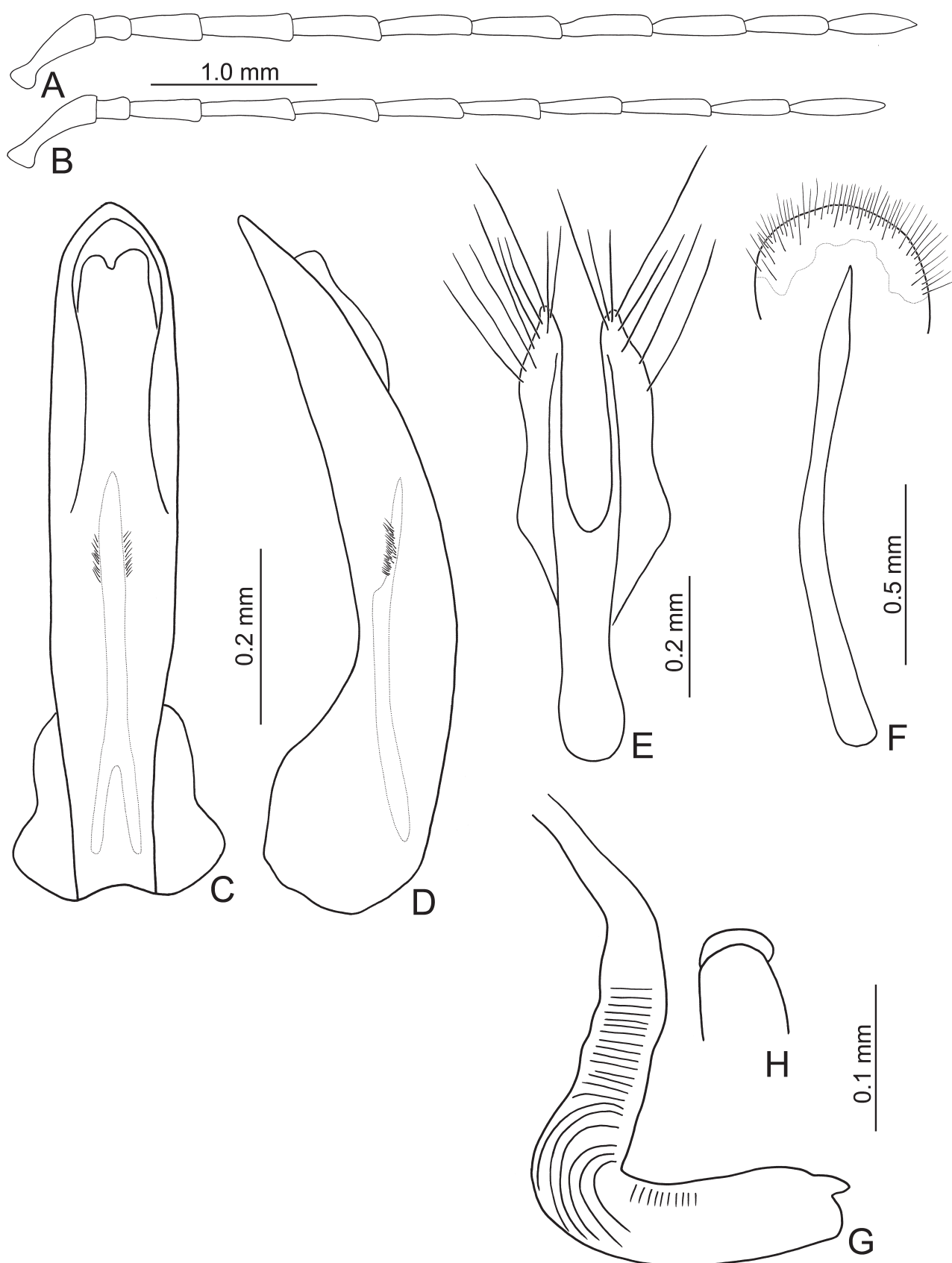


FIGURE 2. Diagnostic characters of *Shairella aeneipennis* Chûjô. 2A. Antenna, male; 2B. Antenna, female; 2C. Penis, dorsal view; 2D. Penis, lateral view; 2E. Gonocoxae; 2F. Abdominal ventrite VIII; 2G. Spermatheca; 2H. Apex of pump, dorsal view.

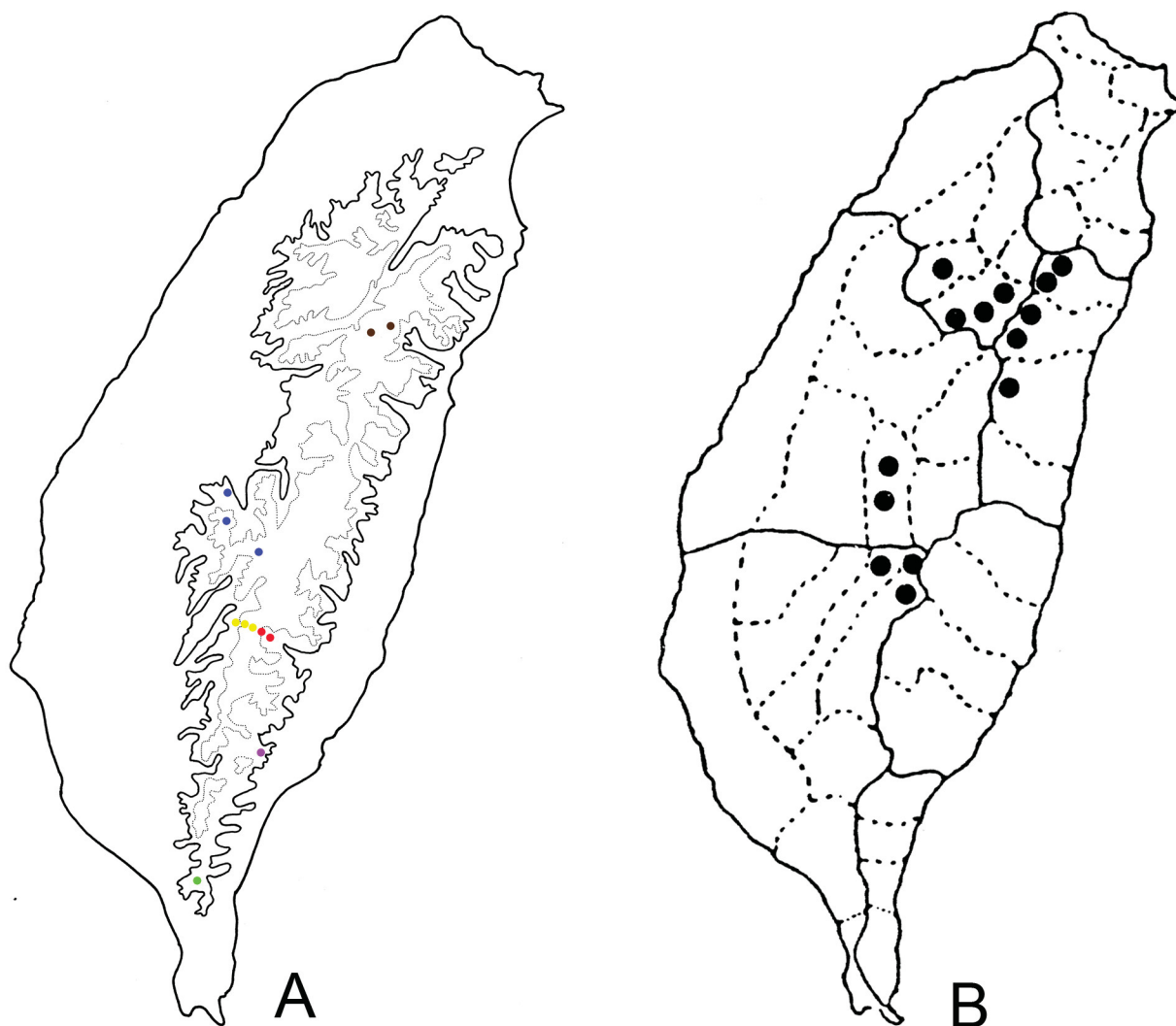


FIGURE 3. Distribution map of *Shairella* species and *Clinopodium laxiflorum* var. *taiwanianum*. 1A. Solid line: 1000 m, broken line: 2000 m. Red spots: *S. motienensis* **sp. nov.**; blue spots: *S. aeneipennis* Chûjô; gray spots: *S. tsoui* **sp. nov.**; pink spot: *S. cheni* **sp. nov.**; green spot: *S. chungii* **sp. nov.**; yellow spot: *S. guoi* **sp. nov.**; 1B. *Clinopodium laxiflorum* var. *taiwanianum* (after Hsieh & Huang 1999).

Remarks. The allotype of *S. aeneipennis* is proved to belong to another species (see *S. tsoui* **sp. nov.**).

Host plant. *Clinopodium laxiflorum* var. *taiwanianum* Hsieh & Huang (Labiatae).

Distribution. Chiayi county: Alishan (阿里山); Nantou county: Hsitou (溪頭) and Tatachia (塔塔加) (Fig. 3A).

***Shairella cheni* Lee & Beenen, sp. nov.**
(Fig. 4)

Type locality. Taiwan: Taitung County, Lichia trail (利嘉林道), 22°48'09"N, 120°59'15"E, 1100 m.

Types (n= 12). Holotype ♂ (TARI), **Taitung:** Lichia trail (利嘉林道), 15.VII.2014, leg. B.-X. Guo. Paratypes: 2♂ (TARI), same data as holotype; 1♀ (TARI), same locality, 25.VII.2015, leg. Y.-T. Chung, P.-H. Kuo & S.-P. Wu; 7♂, 1♀ (TARI, RBCN), same locality, 1.VII.2016, leg. B.-X. Guo.

Males. Length 5.7–5.9 mm; width 3.6–3.7 mm. Antenna (Fig. 4A) long, filiform, about 1.1x longer than body, length ratios of antennomeres I–XI 1.0 : 0.3 : 0.7 : 0.9 : 0.8 : 0.9 : 0.9 : 0.8 : 0.8 : 0.8 : 0.8, length to width ratios of antennomeres I–XI 3.4 : 1.6 : 3.1 : 4.2 : 4.1 : 4.6 : 4.6 : 5.1 : 5.5 : 5.0 : 6.0. Elytra apically and weakly widened;

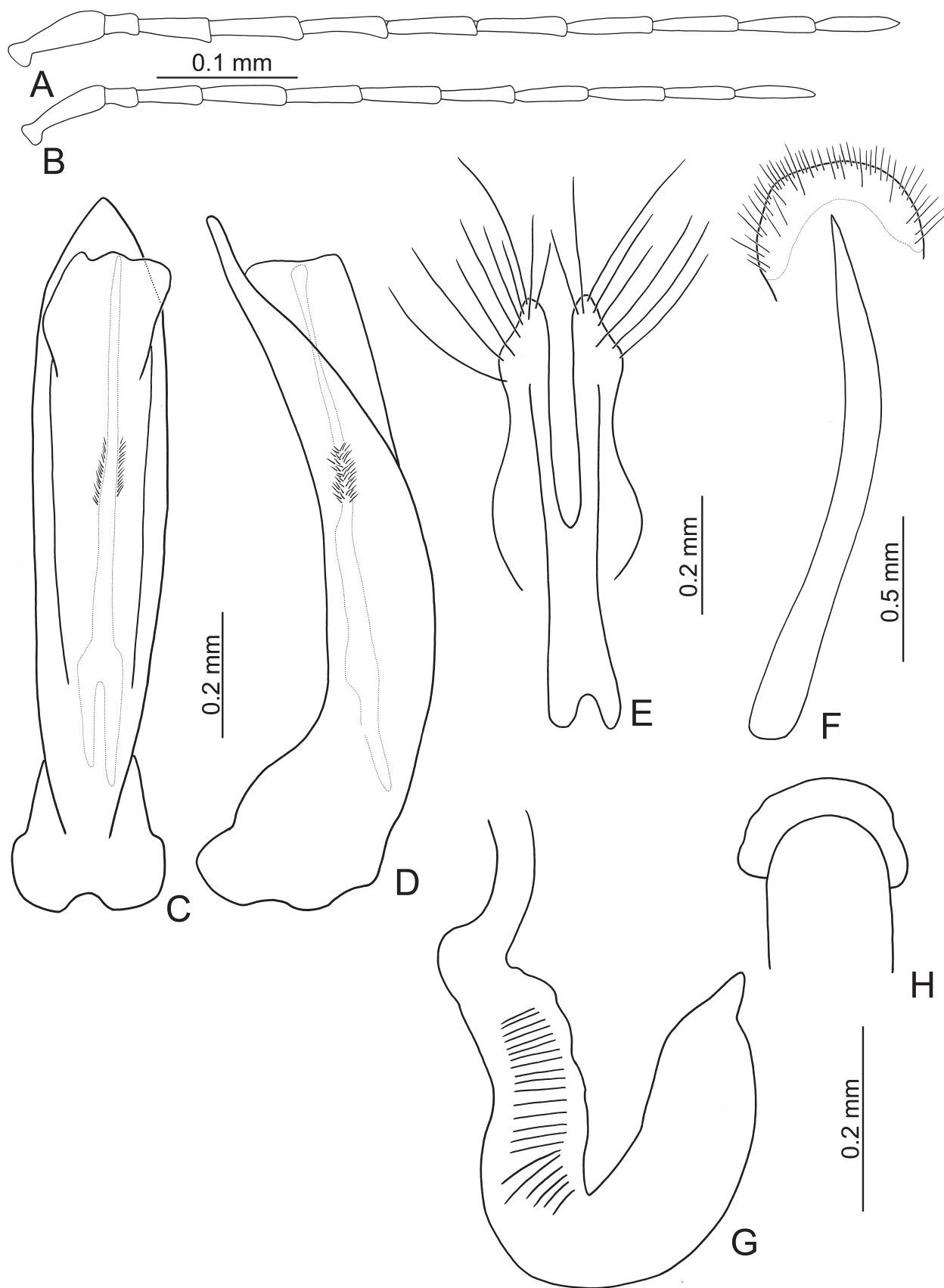


FIGURE 4. Diagnostic characters of *Shairella cheni* **sp. nov.** 4A. Antenna, male; 4B. Antenna, female; 4C. Penis, dorsal view; 4D. Penis, lateral view; 4E. Gonocoxae; 4F. Abdominal ventrite VIII; 4G. Spermatheca; 4H. Apex of pump, dorsal view.

about 1.1x longer than wide; surface with sparse and coarse punctures, and with several indistinct longitudinal ridges. Apical margin of last abdominal ventrite with two well developed incisions. Penis (Figs 4C–4D) elongate, about 5.6x longer than wide, gradually narrowed towards basal 1/5, apically tapering from apical 1/9, strongly curved in lateral view; endophallic sclerite long, about 0.7x as long as penis, slender and longitudinal, apical margin rounded, with dense short hairs along lateral margin at middle, bifurcate at basal 1/6.

Females. Length 6.1–6.2 mm, width 4.1–4.2 mm. Antenna (Fig. 4B) extremely long, filiform, as long as body, length ratios of antennomeres I–XI 1.0 : 0.4 : 0.7 : 0.9 : 0.8 : 0.9 : 0.8 : 0.8 : 0.8 : 0.8 : 0.9, length to width ratios of antennomeres I–XI 3.7 : 1.7 : 3.1 : 4.3 : 4.5 : 4.8 : 4.5 : 5.1 : 5.4 : 5.4 : 7.0. Elytra strongly widened apically; as long as wide; surface with sparse, fine punctures and with several indistinct longitudinal ridges. Apical margin of last abdominal ventrite subtruncate. Gonocoxae (Fig. 4E) longitudinal and narrow, 2.9X longer than wide, conjoined from base to middle, slightly narrowed at apical 1/3, apices rounded, each gonocoxa with eight or nine elongate setae. Ventrite VIII (Fig. 4F) with only apical area and spiculum sclerotized; with dense elongated inside apical sclerotized area, apical margin rounded; spiculum elongate and wide. Receptacle of spermatheca (Fig. 4G) slender, as wide as pump, hardly separated from pump; pump wide and strongly curved, apex broadly rounded, apex with transverse, broad sclerite (Fig. 4H), size variable; proximal spermathecal duct hardly separated from receptacle, apically narrowed.

Differential diagnosis. *Shairella cheni* sp. nov. is similar to *S. chungii* sp. nov. based on the large body size and coarse punctures on the elytra. This species differs from *S. chungii* sp. nov. by the tapering of the penis from the apical 1/4 to apex (Figs 4C–4D) (lanceolate apex in *S. chungii* sp. nov. (Figs 6C–6D)).

Host plant. *Strobilanthes flexicaulis* Hayata (Acanthaceae).

Etymology. This new species is dedicated to Mr. Chang Chin Chen for supporting the TCRT in various ways.

Distribution. Only known from the type locality (Fig. 3A).

***Shairella chungii* Lee & Beenen, sp. nov.**

(Figs 5–6)

Type locality. Pingtung County, Tahanshan (大漢山), 22°24'27"N, 120°45'23"E, 1400 m.

Types (n= 34). Holotype ♂ (TARI), **Pingtung:** Tahanshan (大漢山), 29.VI.2013, leg. B.-X. Guo. Paratypes: 6♂, 3♀ (TARI), same data as holotype; 5♂, 3♀ (TARI, RBCN), same locality, 11.VII.2013, leg. B.-X. Guo; 2♂ (TARI), same locality, 12.VII.2013, leg. Y.-T. Chung; 1♀ (TARI), same locality, 21.VII.2013, leg. Y.-T. Chung; 1♀ (TARI), same locality, 9.VIII.2013, leg. B.-X. Guo; 1♂ (TARI), same locality, 28.VIII.2014, leg. Y.-T. Chung; 3♂, 1♀ (TARI), same locality, 19.V.2015, leg. Y.-T. Chung; 3♂, 1♀ (TARI), same locality, 27.V.2015, leg. Y.-T. Chung; 1♂, 3♀ (TARI), same locality, 6.VI.2015, leg. Y.-T. Chung.

Males (Figs 5A–5C). Length 6.2–6.7 mm; width 3.7–3.9 mm. Antenna (Fig. 6A) long, filiform, about 1.1x longer than body, length ratios of antennomeres I–XI 1.0 : 0.3 : 0.7 : 1.0 : 0.9 : 0.8 : 0.8 : 0.8 : 0.8 : 0.8 : 0.9, length to width ratios of antennomeres I–XI 3.3 : 1.8 : 3.1 : 4.6 : 4.4 : 4.4 : 4.5 : 5.5 : 6.1 : 5.4 : 7.0. Elytra apically weakly broadened; about 1.2–1.3x longer than wide; surface with sparse, coarse punctures and several indistinct longitudinal ridges. Apical margin of last abdominal ventrite with two well developed incisions. Penis (Figs 6C–6D) elongate, about 5.1x longer than wide, gradually narrowed towards middle, apex lanceolate, strongly curved in lateral view; endophallic sclerite long, about 0.8x as long as penis, slender and longitudinal, apical margin rounded, with dense short hairs along lateral margin at middle, bifurcate at basal 1/6.

Females (Figs 5D–5F). Length 6.9–7.3 mm, width 4.5–4.7 mm. Antenna (Fig. 6B) long, filiform, as long as body, length ratios of antennomeres I–XI 1.0 : 0.3 : 0.7 : 0.9 : 0.9 : 0.8 : 0.8 : 0.8 : 0.8 : 0.8 : 0.8, length to width ratios of antennomeres I–XI 4.0 : 1.5 : 3.1 : 4.6 : 4.9 : 5.5 : 5.3 : 5.6 : 6.5 : 5.8 : 7.1. Elytra strongly broadened apically; about 1.0–1.1x longer than wide; surface with sparse, fine punctures and several indistinct longitudinal ridges. Apical margin of last abdominal ventrite subtruncate. Gonocoxae (Fig. 6E) longitudinal and narrow, 3.2x longer than wide, conjoined from base to middle, slightly narrowed in apical 1/3, apices rounded, each gonocoxa with eight elongate setae. Ventrite VIII (Fig. 6F) with only apical area and spiculum sclerotized; with dense elongate setae inside apical sclerotized area, apical margin rounded; spiculum elongate and broad. Receptacle of spermatheca (Fig. 6G) slender, as wide as pump, hardly separated from pump; pump broad and strongly curved, apex broadly rounded, apex with transverse, broad sclerite (Fig. 6H), size variable; proximal spermathecal duct hardly separated from receptacle, apically narrowed.

Differential diagnosis. See diagnosis of *Shairella cheni* sp. nov.

Host plants. *Strobilanthes flexicaulis* Hayata (Acanthaceae) and *Hemiboea bicornuta* (Hayata) Ohwi (Gesneriaceae).

Etymology. The new species is dedicated to Mr. Yi-Ting Chung, who collected the type specimens.

Distribution. Only known from the type locality (Fig. 3A).

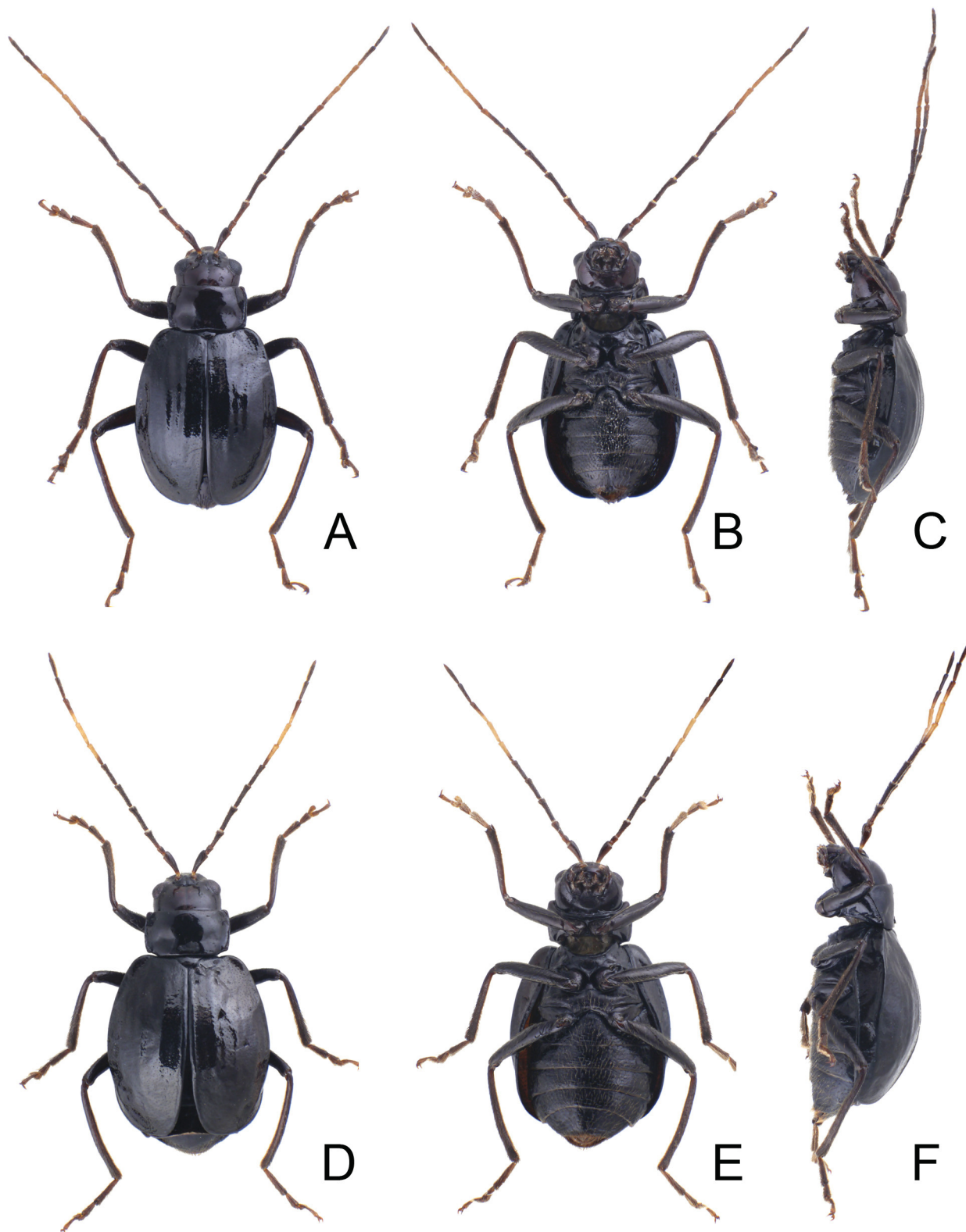


FIGURE 5. Habitus of *Shairella chungi* sp. nov. 5A. Male, dorsal view; 5B. Same, ventral view; 5C. Same, lateral view; 5D. Female, dorsal view; 5E. Same, ventral view; 5F. Same, lateral.

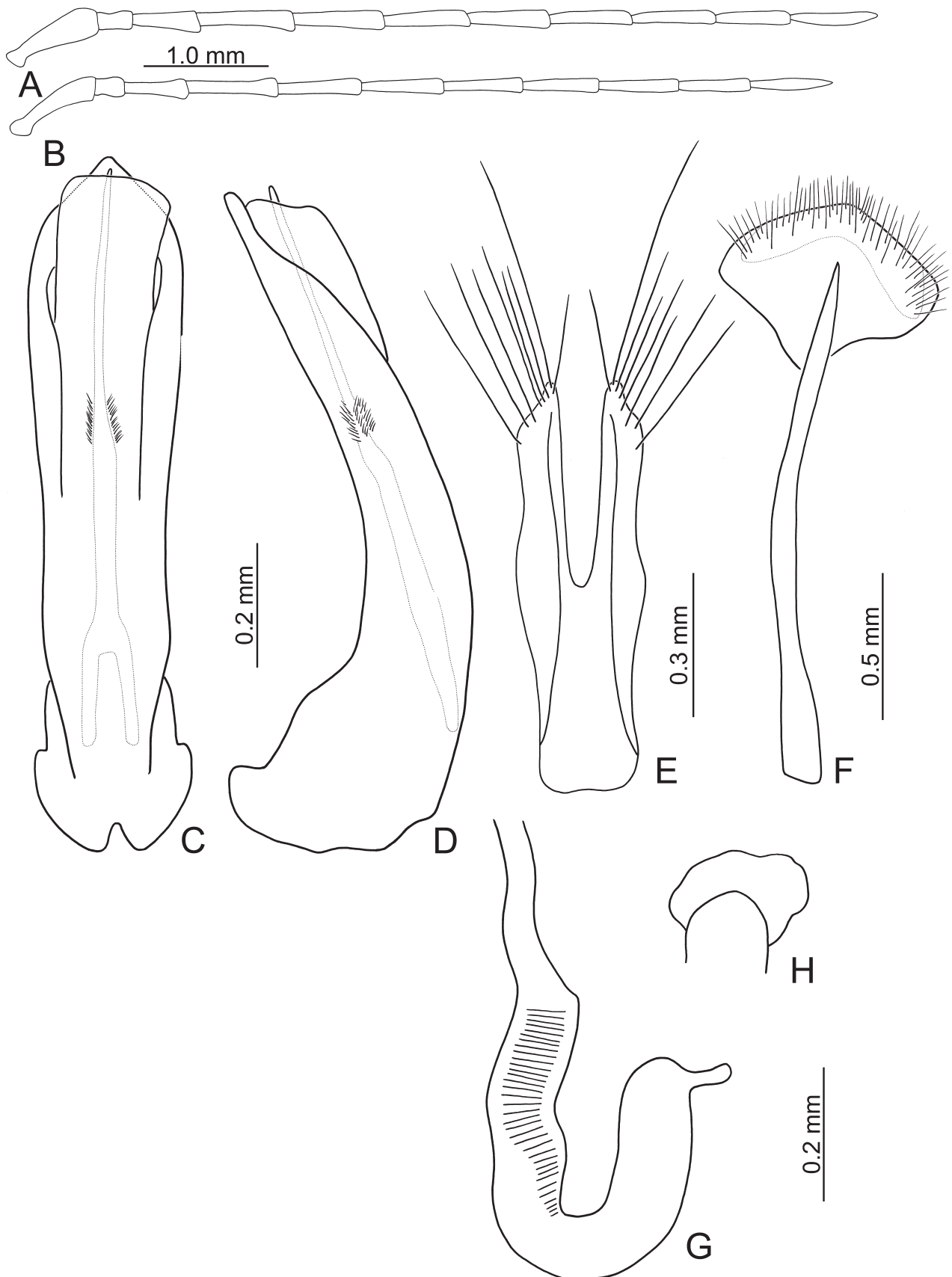


FIGURE 6. Diagnostic characters of *Shairella chungii* **sp. nov.** 6A. Antenna, male; 6B. Antenna, female; 6C. Penis, dorsal view; 6D. Penis, lateral view; 6E. Gonocoxae; 6F. Abdominal ventrite VIII; 6G. Spermatheca; 6H. Apex of pump, dorsal view.

***Shairella guoi* Lee & Beenen, sp. nov.**
(Figs 7–8)

Type locality. Taiwan: Kaoshiung County, Tienchih (天池), 23°16'37"N, 120°55'01"E, 2200 m.

Types (n= 27). Holotype ♂ (TARI), **Kaohsiung**: Tienchih (天池), 17.V.2015, leg. B.-X. Guo. Paratypes: 3♂, 2♀ (TARI), same data as holotype; 10♂, 9♀ (TARI, RBCN), Kueiku (檜谷), 11.VI.2015, leg. C.-F. Lee; 2♀ (TARI), Kuanshanyakou (關山啞口), 30.VII.2015, leg. C.-F. Lee.

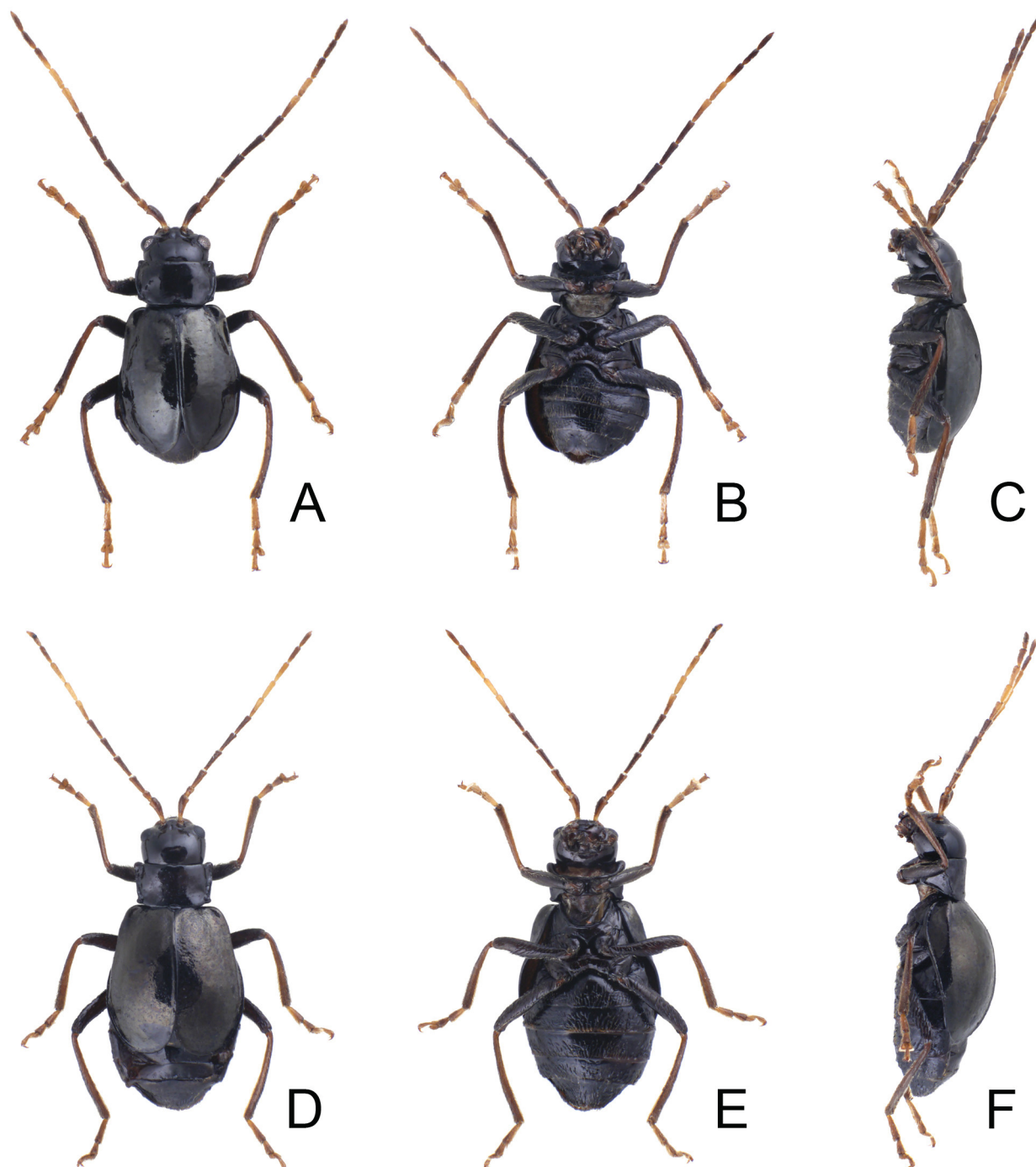


FIGURE 7. Habitus of *Shairella guoi* sp. nov. 7A. Male, dorsal view; 7B. Same, ventral view; 7C. Same, lateral view; 7D. Female, dorsal view; 7E. Same, ventral view; 7F. Same, lateral.

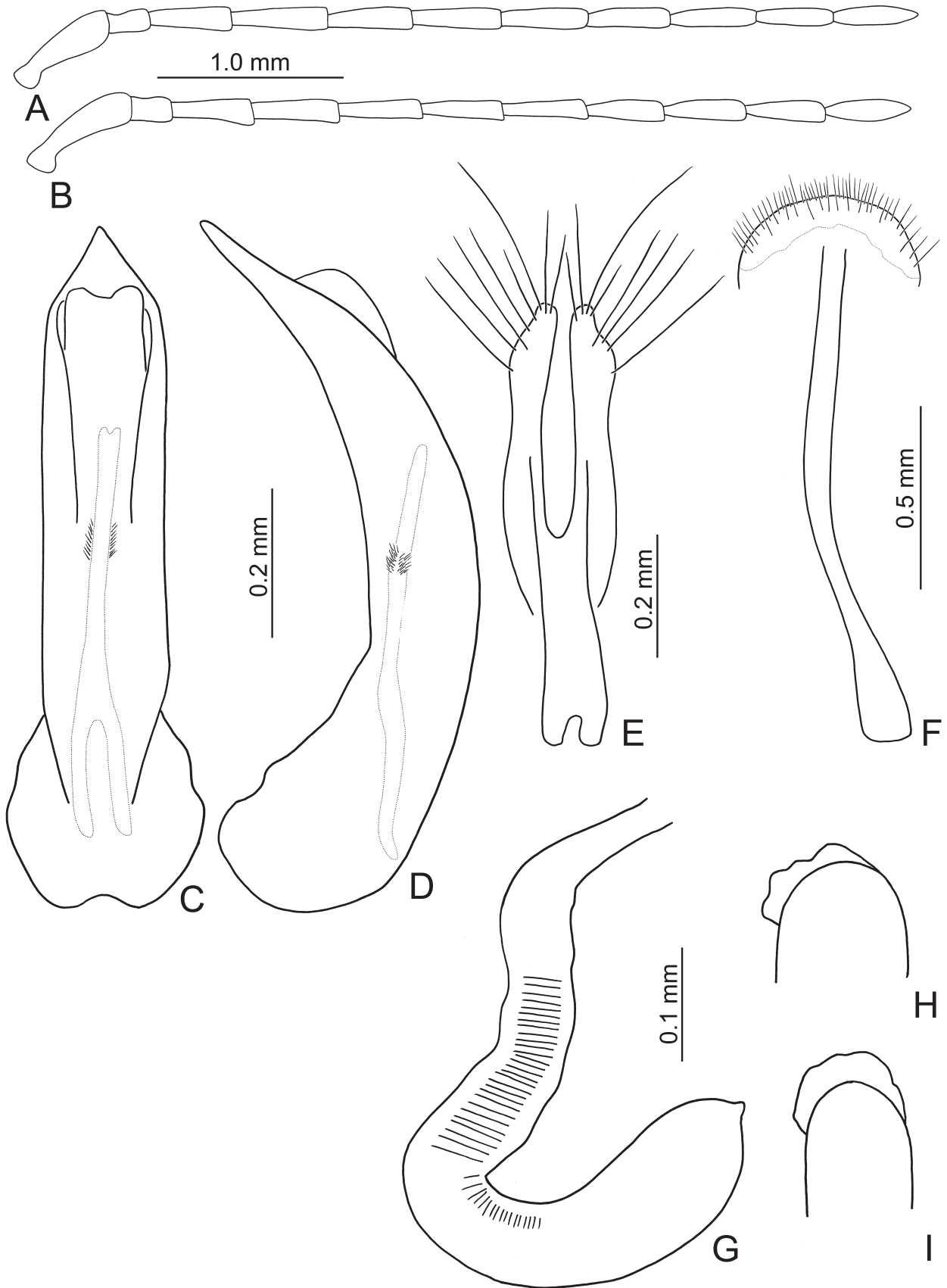


FIGURE 8. Diagnostic characters of *Shairella guoi* sp. nov. 8A. Antenna, male; 8B. Antenna, female; 8C. Penis, dorsal view; 8D. Penis, lateral view; 8E. Gonocoxae; 8F. Abdominal ventrite VIII; 8G. Spermatheca; 8H. Apex of pump, dorsal view; 8I. Same, variation.

Males (Figs 7A–7C). Length 4.3–4.6 mm; width 2.5–2.7 mm. Antenna (Fig. 8A) long, filiform, about 1.2x longer than body, length ratios of antennomeres I–XI 1.0 : 0.4 : 0.8 : 0.9 : 0.8 : 0.8 : 0.8 : 0.8 : 0.7 : 0.8, length to width ratios of antennomeres I–XI 3.2 : 1.9 : 3.6 : 4.2 : 3.6 : 4.1 : 4.0 : 4.1 : 4.5 : 4.1 : 4.8. Elytra strongly broadened apically; about 1.1x longer than wide; surface with sparse, fine punctures. Apical margin of last abdominal ventrite with two well developed incisions. Penis (Figs 8C–8D) elongate, about 6.9x longer than wide, parallel-sided, apically tapering from apical 1/6, strongly curved in lateral view; endophallic sclerite short, about 0.5x as long as penis, slender and longitudinal, apical margin medially depressed, with dense short hairs along lateral margin at apical 1/3, bifurcate at basal 1/4.

Females (Figs 7D–7F). Length 5.0–5.3 mm, width 3.2–3.3 mm. Antenna extremely long, filiform, as long as body, length ratios of antennomeres I–XI 1.0 : 0.3 : 0.7 : 0.7 : 0.7 : 0.7 : 0.8 : 0.7 : 0.7 : 0.7 : 0.7, length to width ratios of antennomeres I–XI 3.5 : 1.5 : 2.9 : 3.3 : 4.1 : 4.0 : 4.4 : 3.9 : 4.1 : 3.9 : 4.3. Elytra strongly widened apically; about 1.0–1.1x longer than wide; surface with sparse, fine punctures. Apical margin of last abdominal ventrite truncate. Gonocoxae (Fig. 8E) longitudinal and narrow, 3.8x longer than wide, conjoined from base to middle, slightly narrowed at apical 1/3, apices rounded, each gonocoxa with eight elongate setae. Ventrite VIII (Fig. 8F) with only apical area and spiculum sclerotized; with dense elongate setae inside apical sclerotized area, apical margin rounded; spiculum elongate and broad. Receptacle of spermatheca (Fig. 8G) slender, as wide as pump, hardly separated from pump; pump broad and strongly curved, apex broadly rounded, apex with transverse, short sclerite, size variable (Figs 8H–8I); proximal spermathecal duct hardly separated from receptacle, apically narrowed.

Differential diagnosis. See diagnosis of *Shairella aeneipennis* Chûjô.

Host plant. *Clinopodium laxiflorum* var. *taiwanianum* Hsieh & Huang (Labiatae).

Etymology. The new species is dedicated to Mr. Bo-Xin Guo, who collected the type specimens.

Distribution. Vicinity along western half of South Cross-Island Highway (南橫公路) (Fig. 3A).

Shairella motienensis Lee & Beenen, sp. nov.

(Fig. 9)

Type locality. Taiwan: Taitung County, Motien (摩天), 23°11'35"N, 121°01'24"E, 1500 m.

Types (n= 54). Holotype ♂ (TARI), Taitung: Motien (摩天), 20.VI.2011, leg. C.-F. Lee. Paratypes: 24♂, 8♀ (TARI, RBCN), same data as holotype; 3♂ (TARI), Liyuan (栗園), 23.VI.2010, leg. M.-H. Tsou; 1♂ (TARI), same locality, 3.X.2010, leg. M.-H. Tsou; 2♂, 3♀ (TARI), same locality, 19.VI.2013, leg. C.-F. Lee; 8♂, 4♀ (TARI), same locality, 24.VII.2013, leg. C.-F. Lee.

Males. Length 4.6–5.1 mm; width 2.7–3.1 mm. Antenna (Fig. 9A) long, filiform, about 1.3x longer than body, length ratios of antennomeres I–XI 1.0 : 0.4 : 0.8 : 0.9 : 0.9 : 0.9 : 0.8 : 0.9 : 0.8 : 0.9, length to width ratios of antennomeres I–XI 3.3 : 1.8 : 3.2 : 3.7 : 4.0 : 4.2 : 4.2 : 4.5 : 5.0 : 4.8 : 5.2. Elytra apically, moderately broadened; about 1.2x longer than wide; surface with sparse, fine punctures. Apical margin of last abdominal ventrite with two well developed incisions. Penis (Figs 9C–9D) elongate, about 5.3x longer than wide, parallel-sided, apex lanceolate, moderately curved in lateral view; endophallic sclerite long, about 0.7x as long as penis, slender and longitudinal, apically tapering, with dense short hairs along lateral margin in apical 1/4, bifurcate at basal 1/4.

Females. Length 5.4–6.4 mm, width 3.5–3.9 mm. Antenna (Fig. 9B) long, filiform, 1.2x longer than body, length ratios of antennomeres I–XI 1.0 : 0.4 : 0.7 : 0.9 : 0.9 : 0.8 : 0.9 : 0.8 : 0.8 : 0.7 : 0.9, length to width ratios of antennomeres I–XI 3.6 : 1.2 : 2.9 : 4.1 : 4.4 : 4.7 : 4.8 : 5.8 : 5.7 : 5.2 : 6.1. Elytra strongly broadened apically; about 1.1x longer than wide; surface with sparse, fine punctures. Apical margin of last abdominal ventrite slightly convex at middle (Fig. 9G). Gonocoxae (Fig. 9E) longitudinal and broad, 3.0x longer than wide, conjoined from base to middle, slightly narrowed at apical 1/3, apices rounded, each gonocoxa with seven or eight elongate setae. Ventrite VIII (Fig. 9F) with only apical area and spiculum sclerotized; with dense elongate setae inside apical sclerotized area, apical margin rounded; spiculum elongate and broad. Receptacle of spermatheca (Fig. 9K) slender, as wide as pump, hardly separated from pump; pump broad, strongly curved, apex broadly rounded, apex with transverse, short sclerite, size extremely variable (Figs 9H–9J); proximal spermathecal duct hardly separated from receptacle, apically narrowed.

Differential diagnosis. See diagnosis of *Shairella aeneipennis* Chûjô.

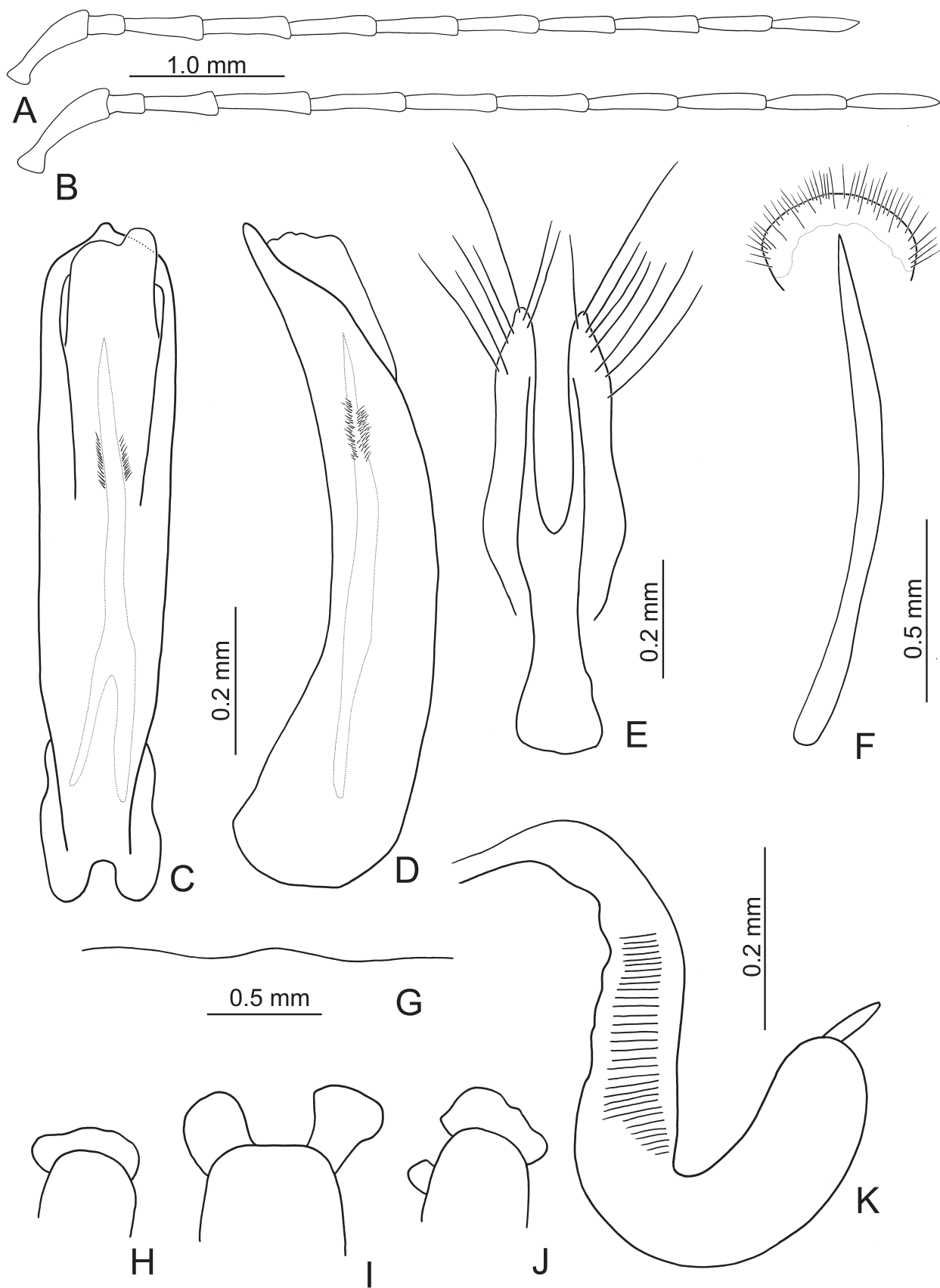


FIGURE 9. Diagnostic characters of *Shairella motienensis* **sp. nov.** 9A. Antenna, male; 9B. Antenna, female; 9C. Penis, dorsal view; 9D. Penis, lateral view; 9E. Gonocoxae; 9F. Abdominal ventrite VIII; 9G. Apical margin of abdominal ventrite V; 9H. Apex of pump, dorsal view; 9I. Same, variation; 9J. Same, variation; 9K. Spermatheca.

Host plant. *Clinopodium laxiflorum* var. *taiwanianum* Hsieh & Huang (Labiatae).

Etymology. This new species is named after the type locality.

Distribution. Vicinity along eastern half of South Cross-Island Highway (南橫公路) (Fig. 3A).

***Shairella tsoui* Lee & Beenen, sp. nov.**

(Figs 10–11)

Shairella aeneipennis Chûjô, 1962: 105. (part)

Type locality. Taiwan: Hualien County, Kuanyuan (關原), 24°11'03"N, 121°20'32"E, 2300 m.

Types (n= 79). Holotype ♂ (TARI), **Hualien:** Kuanyuan (關原), 2.VI.2016, leg. C.-F. Lee. Paratypes: 11♂, 15♀ (TARI, RBCN), same data as holotype; 5♂, 6♀ (TARI), same locality, 2.VI.2016, leg. Y.-T. Chung; 10♂, 10♀, same locality, 2.VI.2016, leg. B.-X. Guo; **Taichung:** 3♂, 2♀ (TARI), Pilu (畢祿), 8.VIII.2014, leg. S.-F. Yu; 5♀ (TARI), same locality, 8.VIII.2014, leg. M.-H. Tsou; 2♂, 5♀ (TARI), same locality, 7.VII.2015, leg. C.-F. Lee; 4♂ (TARI), same locality, 3.VI.2016, leg. B.-X. Guo; 1♀ (TARI), labeled “TAIWAN / HASSENZAN (= Pahsienshan, 八仙山) [p] / 4.VI.1942 [h] / A. MUTUURA [p, w] // 佳保台 (Chiapaotai)—黎明 (Liming) [h, on the back of the same label] // *Shairella / aeneipennis* / CHÛJÔ [h] / DET. M. CHUJO [p, w] // ALLO / Type [p, w, circle label with gray letters]”.

Males (Figs 10A–10C). Length 4.5–5.0 mm; width 2.6–2.7 mm. Antenna (Fig. 11A) long, filiform, about 1.3x longer than body, length ratios of antennomeres I–XI 1.0 : 0.4 : 0.8 : 1.0 : 0.9 : 0.9 : 1.0 : 0.8 : 0.8 : 0.8 : 0.9, length to width ratios of antennomeres I–XI 2.8 : 1.6 : 2.8 : 3.6 : 3.3 : 3.8 : 3.9 : 3.3 : 3.9 : 4.0 : 4.4. Elytra apically, moderately broadened; about 1.1–1.3x longer than wide; surface with sparse, coarse punctures and with several longitudinal indistinct ridges. Apical margin of last abdominal ventrite with two well developed incisions. Penis (Figs 11C–11D) extremely slender, about 8.0x longer than wide, apically tapering from basal 1/3, moderately curved at basal 1/3 in lateral view; endophallic sclerite short, about 0.4x as long as penis, slender and longitudinal, apex pointed, with dense, short hairs along lateral margin in apical 1/4, bifurcate at basal 1/4.

Females (Figs 10D–10F). Length 5.2–5.4 mm, width 3.5–3.6 mm. Antenna (Fig. 11B) long, filiform, 1.2x longer than body, length ratios of antennomeres I–XI 1.0 : 0.4 : 0.7 : 0.9 : 0.8 : 0.8 : 0.8 : 0.8 : 0.7 : 0.7 : 0.8, length to width ratios of antennomeres I–XI 3.2 : 1.5 : 2.6 : 3.8 : 3.7 : 3.8 : 3.8 : 3.9 : 3.7 : 3.7 : 5.1. Elytra strongly broadened apically; about 1.0–1.1x longer than wide; surface with sparse and coarse punctures. Apical margin of last abdominal ventrite with median notch (Fig. 11G). Gonocoxae (Fig. 11E) longitudinal, broad, 2.9x longer than wide, conjoined from base to middle, slightly narrowed at apical 1/3, apices rounded, each gonocoxa with seven or nine elongate setae. Ventrite VIII (Fig. 11F) without sclerotized areas but spiculum sclerotized; with dense elongate setae along apical margin, apical margin irregular; spiculum elongate and broad. Receptacle of spermatheca (Fig. 11H) slender, as wide as pump, hardly separated from pump; pump broad, strongly curved, apex broadly rounded, apex with transverse, tiny sclerite (Fig. 11I); proximal spermathecal duct hardly separated from receptacle, apically narrowed.

Remarks. The allotype of *Shairella aeneipennis* Chûjô is misidentified and belongs to *S. tsoui* sp. nov.. It is a member to this species.

Differential diagnosis. *Shairella tsoui* sp. nov. appears similar to *S. chungii* sp. nov. and *S. cheni* sp. nov. based on the coarse punctures of the elytra; but this species can be separated from them with their smaller sizes, the slender and apically tapering penis, the long endophallic sclerite, and presence of the median notch on the apical margin of the last abdominal ventrite in females.

Host plant. *Clinopodium laxiflorum* var. *taiwanianum* Hsieh & Huang (Labiatae).

Etymology. The new species is dedicated to Mr. Mei-Hua Tsou, who collected the type specimens.

Distribution. Kuanyuan (關原), Hualien County and Pilu (畢祿), Taichung County (Fig. 3A).

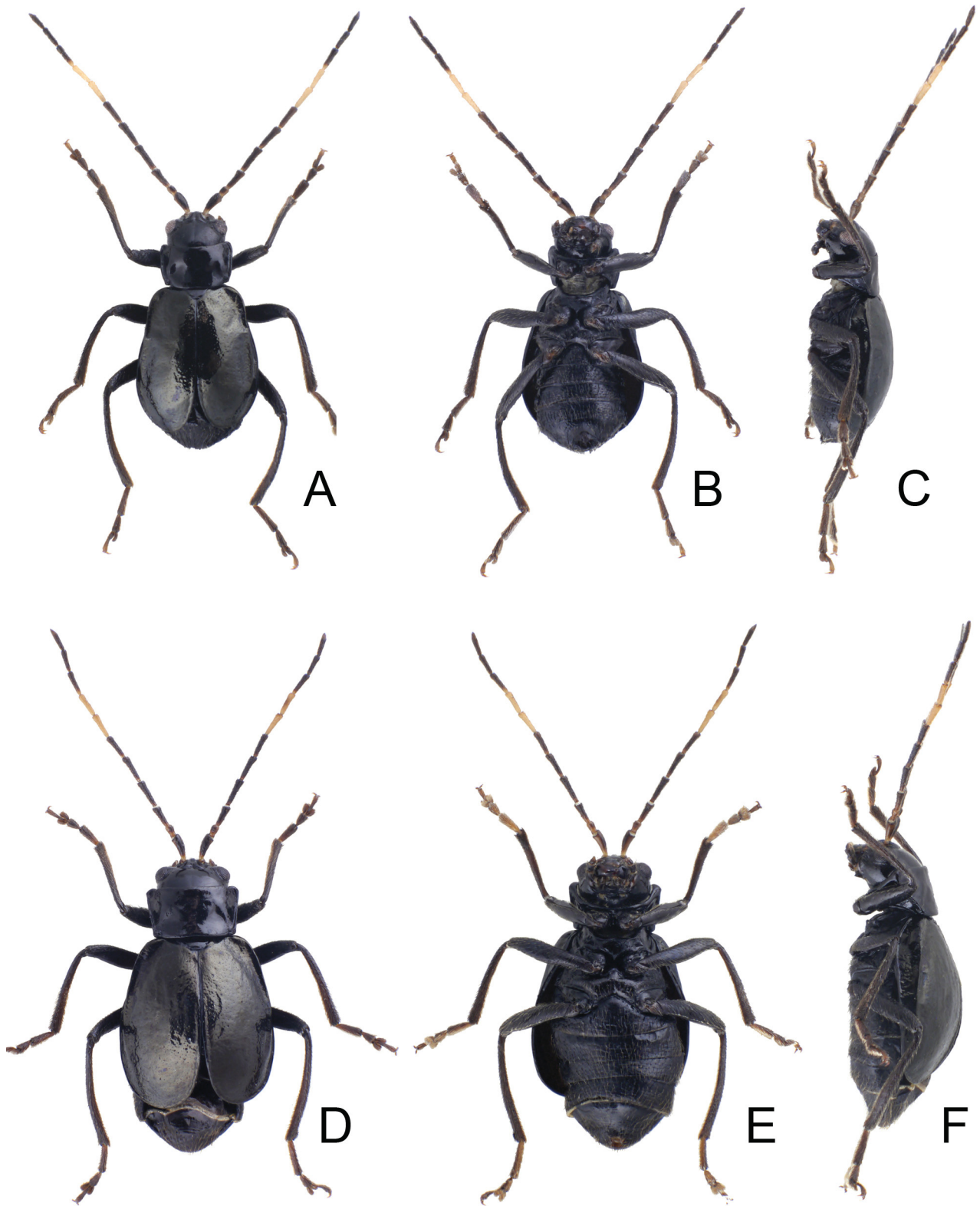


FIGURE 10. Habitus of *Shairella tsoui* sp. nov. 10A. Male, dorsal view; 10B. Same, ventral view; 10C. Same, lateral view; 10D. Female, dorsal view; 10E. Same, ventral view; 10F. Same, lateral.

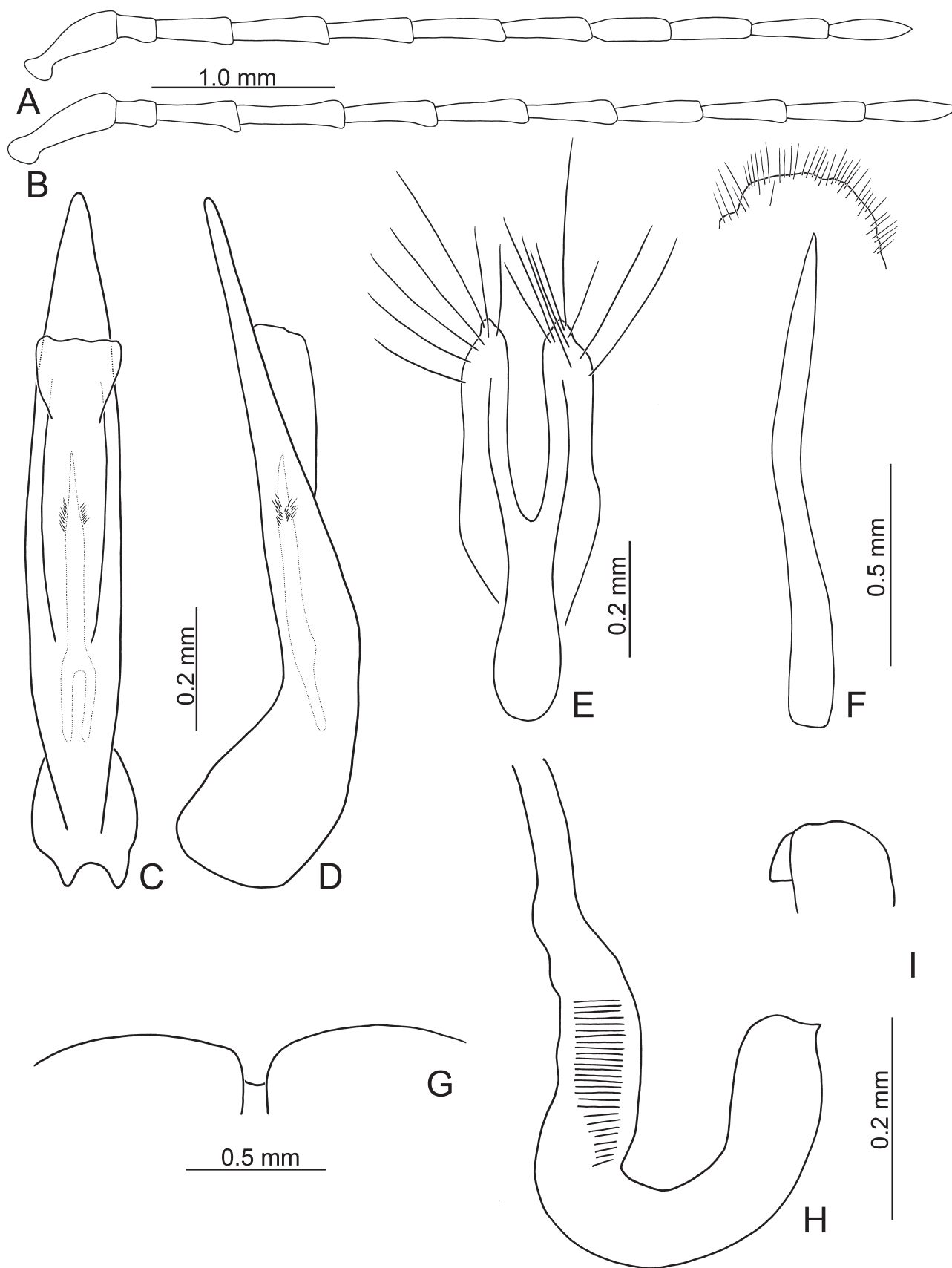


FIGURE 11. Diagnostic characters of *Shairella tsoui* **sp. nov.** 11A. Antenna, male; 11B. Antenna, female; 11C. Penis, dorsal view; 11D. Penis, lateral view; 11E. Gonocoxae; 11F. Abdominal ventrite VIII; 1G. Apical margin of abdominal ventrite V; 11H. Spermatheca; 11I. Apex of pump, dorsal view.

Key to species of *Shairella*

1. Punctures on elytra fine. 2
- Punctures on elytra coarse. 4
2. Apex of penis lanceolate; endophallic sclerite longer (0.7x as long as penis), apex pointed (Figs 9C–9D) *S. motienensis* sp. nov.
- Apex of penis narrowly rounded or tapering from apical 1/6; endophallic sclerite shorter (0.5x as long as penis), apex depressed or rounded. 3
3. Apex of penis narrowly rounded; apex of endophallic sclerite rounded (Figs 2C–2D) *S. aeneipennis* Chûjô
- Apex of penis tapering from apical 1/6; apex of endophallic sclerite depressed (Figs 8C–8D) *S. guoi* sp. nov.
4. Small size (males ≤ 5.0 mm and females ≤ 5.4 mm in length); penis slender (8.0x longer than wide) and apically tapering from basal 1/3, endophallic sclerite shorter (0.4x as long as penis) (Figs 11C–11D); apical margin of last abdominal ventrite in females with median notch (Fig. 11G); antennae relatively stout, antennomeres VI–X less than 4.0 x longer than wide *S. tsoui* sp. nov.
- Large size (males ≥ 5.7 mm and females ≥ 6.1 mm in length); penis wider (5.1–5.6x longer than wide) and parallel-sided; endophallic sclerite longer (0.7–0.8x as long as penis), apical margin of last abdominal ventrite in females slightly convex or truncate (Figs 4C–4D, 6C–6D); antennae relatively more elongate, antennomeres VI–X more than 4.0 x longer than wide. . . 5
6. Apex of penis lanceolate (Figs 6C–6D) *S. chungii* sp. nov.
- Apex of penis tapering from apical 1/9 (Figs 4C–4D) *S. cheni* sp. nov.

Discussion

Members of *Shairella* can be identified to species by their aedeagal characters and distributions. Most other morphological characters are less diagnostic except characters such as size of punctures on the elytra and relative lengths of antennomeres for some species, and one apparent autapomorphy in females of *S. tsoui* sp. nov., a median notch on the posterior margin of the last abdominal ventrite.

The taxonomic status of *Shairella* with respect to other genera is unclear. Although adults are similar to those of *Shaira*, the morphology of the prosternal process differs clearly between members of these two genera. The procoxal cavities are closed in *Shairella* and open in *Shaira*. Although both genera are classified by Wilcox (1971–1975) as members of the tribe Luperini, the morphology of the last abdominal sternite in the males and the metasternal process that, although small, separates the metacoxal cavities, in contrast to other members of the tribe. So, the classification needs further study. Only a phylogenetic study of these and other genera tentatively assembled as the section Adoxiites by Wilcox (1971–1975) will clarify this systematic puzzle. Such an analysis is beyond the scope of our study.

The distributions of most *Shairella* species (Fig. 3A) seem to be determined by their host plant—*Clinopodium laxiflorum* var. *taiwanianum* Hsieh & Huang (Labiatae) (Fig. 3B). This plant grows in middle elevations (1500–2500 m) of central and southern Taiwan (Hsieh & Huang 1999). Most species of *Shairella* are monophagous and their distribution is coincident with the distribution of this plant. Two exceptions, *Shairella chungii* sp. nov. and *S. cheni* sp. nov. live in southern and southeastern Taiwan, which is out of range of *Clinopodium laxiflorum* var. *taiwanianum*. The host plants of these species are *Strobilanthes flexicaulis* Hayata (Acanthaceae) and *Hemiboea bicornuta* (Hayata) Ohwi (Gesneriaceae), which are abundant at low elevations.

This genus is another example in support of the hypothesis of brachelytry in leaf beetles of tropical forest habitats proposed by Lee (2015): “Reduction of hind wings may result from the production of physogastric females. Nocturnal behavior increases survival since natural enemies are less of a threat. Males actively search for mates by night. As like survival in harsh environments such as islands, deserts and alpine regions, flight is not essential and energy can be diverted to egg production (Beenen & Jolivet 2008). Thus, brachelytry is a predictable evolutionary trend.” Other examples consistent with this hypothesis include Taiwanese populations of *Paraplotes* (Lee 2015) and *Sikkimia* (Lee & Bezděk 2016) that are nocturnally active and have brachelytrous females. *Shairella* is typical of a few genera of galerucines that are brachelytrous (Beenen & Jolivet 2008) in both sexes. Moreover, compound eyes of adult *Shairella* are comparatively small (interocular space 3.2–3.3 times as wide as transverse diameter of eye). Reduction of eyes is also correlated with nocturnal behavior.

One unclarified character is the presence of a white band on the subapical area of the antenna in species that have an entirely black body. A hypothesis is proposed for this character as follow: natural enemies search for *Shairella* adults visually by moonlight. The white bands function as markers to deflect the attacks of predators to

non-vital regions of the body or cause them to miss entirely. Eyespots on butterfly wings are famous samples of this deflection hypothesis (e.g., Stevens 2005, Olofsson *et al.* 2010, Kodandaramaiah *et al.* 2013). Interestingly, this character is also found in *Medythia suturalis* (Motshulsky, 1858) (Fig. 1G) and *Japonitata quadricostata* Kimoto, 1996 (Fig. 1H), which also exhibit nocturnal activity (unpublished data first author). These are good examples of convergent evolution. Another possibility is mimicry, with spiders as models. The long antennae of *Shairella* may look like another pair of legs. However, no good candidates for spider models have been found in Taiwan.

Acknowledgements

We thank the Taiwan Chrysomelid Research Team for assistance in collecting material, including Yi-Ting Chung, Bo-Xin Guo, Hsueh Lee, Ta-Hsiang Lee, Mei-Hua Tsou, and Su-Fang Yu. We especially thank Hou-Jay Chen, Hsueh Lee, and Ta-Hsiang Lee, Wen-Chuan Liao, and Mei-Hua Tsou for taking photographs in the field or of preserved specimens, and Chih-Kai Yang for identification of host plants. I thank Chris Carlton for reading the draft and editing for English style. This study was supported by the Ministry of Science and Technology MOST 105-2313-B-055-001-MY2.

References

- Beenen, R. (2010) Chrysomelidae: Galerucinae. In: Löbl, I. & Semetana, A. (Eds.), *Catalogue of Palaearctic Coleoptera*. Vol. 6. Apollo Books, Stenstrup, pp. 443–491.
- Beenen, R. & Jolivet, P. (2008) Classification and habitat of brachelytrous Chrysomelidae (Coleoptera). In: Jolivet, P., Santiago-Blay, J. & Schmitt, M. (Eds.), *Research on Chrysomelidae*. Vol. 1. Brill, Leiden/Boston, pp. 161–173.
- Bouchard, P., Bousquet, Y., Davies, A.E., Alonso-Zarazaga, M.A., Lawrence, J.F., Lyal, C.H.C., Newton, A.F., Reid, C.A.M., Schmitt, M., Šlipiński, S.A. & Smith, A.B.T. (2011) Family-group names in Coleoptera (Insecta). *ZooKeys*, 88, 1–972. <https://doi.org/10.3897/zookeys.88.807>
- Chûj, M. (1962) A taxonomic study on the Chrysomelidae (Insecta: Coleoptera) from Formosa Part XI. Subfamily Galerucinae. *The Philippine Journal of Science*, 91, 1–239.
- Hsieh, T.-H. & Huang, T.-C. (1999) The geographical distribution and climatic environment of *Clinopodium* in Taiwan. *Annual of the National Taiwan Museum*, 42, 1–9. [in Chinese]
- Kimoto, S. (1984) Notes on the Chrysomelidae from Taiwan, China XI. *Entomological Review of Japan*, 39, 39–58.
- Kimoto, S. & Chu, Y.-I. (1996) Systematic catalog of Chrysomelidae of Taiwan (Insecta: Coleoptera). *Bulletin of the Institute of Comparative Studies of International Cultures and Societies*, 16, 1–152.
- Kimoto, S. & Takizawa, H. (1997) Leaf beetles (Chrysomelidae) of Taiwan. Tokai University Press, Tokyo, 581 pp.
- Kodandaramaiah, U., Lindenfors, P. & Tullberg, B.S. (2013) Deflective and intimidating eyespots: a comparative study of eyespot size and position in *Junonia* butterflies. *Ecology and Evolution*, 3, 4518–4524. <https://doi.org/10.1002/ece3.831>
- Lee, C.-F. (2015) The genus *Paraplotes* Laboissière, 1933 in Taiwan, a speciose group with brachelytrous females (Coleoptera: Chrysomelidae: Galerucinae). *Zootaxa*, 3904 (2), 223–248. <https://doi.org/10.11646/zootaxa.3904.2.3>
- Lee, C.-F. & Bezděk, J. (2016) Revision of the wingless *Sikkimia* Duvivier (Coleoptera, Chrysomelidae, Galerucinae) from Taiwan, including a new generic synonymy and four new species descriptions. *ZooKeys*, 553, 79–106. <https://doi.org/10.3897/zookeys.553.6576>
- Olofsson, M., Vallin, A., Jakobsson, S. & Wiklund, C. (2010) Marginal eyespots on butterfly wings deflect bird attacks under low light intensities with UV wavelengths. *PLoS ONE*, 5, e10798. <https://doi.org/10.1371/journal.pone.0010798>
- Stevens, M. (2005) The role of eyespots as anti-predator mechanisms, principally demonstrated in the Lepidoptera. *Biological Review*, 80, 1–16. <https://doi.org/10.1017/S1464793105006810>
- Wilcox, J.A. (1971–1975) Chrysomelidae. Galerucinae. *Coleopterorum Catalogus Supplementarum*, 78, 1–770.